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Lee et al.

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(54) **MOLD, A DEVICE FOR PROCESSING THE SAME, AND A REPLICA MADE THEREFROM**

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(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

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B23B 27/00 (2006.01)
B23B 29/12 (2006.01)
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CPC .... ***B23B 29/125*** (2013.01); ***B23B 5/48*** (2013.01); ***G02B 5/0231*** (2013.01); (Continued)

(58) **Field of Classification Search**
CPC B32B 3/00; B28B 7/28; B23B 3/00; B23B 5/48; B23B 29/125; B23B 2226/31; G02B 5/0231; G02B 5/0278; G02B 5/045; G02B 5/0268; G02B 6/0065; G02B 6/0053
USPC 428/156; 249/175; 82/134
See application file for complete search history.

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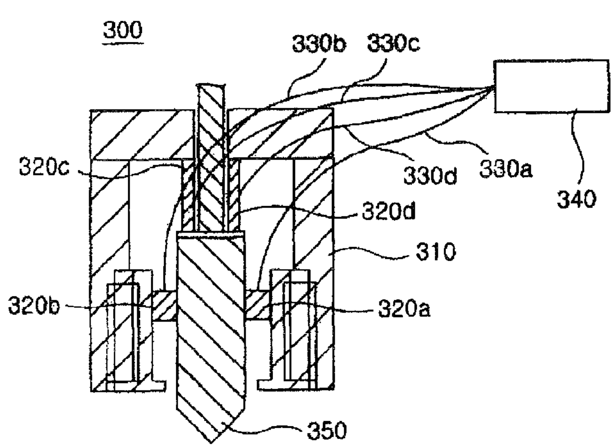
(57) **ABSTRACT**

The present invention is directed to a mold. The present invention is also directed to a device for processing the same, and a replica made therefrom. A device for processing the mold comprises a cutting unit carving a surface of the mold; a housing accommodating the cutting unit and having an aperture through which a portion of the cutting unit protrudes; at least one piezo-electric element disposed between the cutting unit and the housing; and a signal generator applying an electrical signal to the piezoelectric element. The mold comprises a plurality of linear peaks and grooves that are formed on a surface of the mold, wherein both or one of the peaks and grooves have random or periodic meandering-shape. A replica manufactured by the mold comprises a plurality of linear crests and valleys that are formed on a surface of the replica, wherein both or one of the crests and valleys have random or periodic meandering-shape.

8 Claims, 9 Drawing Sheets



(51) **Int. Cl.**

B23B 5/48	(2006.01)
G02B 5/02	(2006.01)
G02B 5/04	(2006.01)
F21V 8/00	(2006.01)

(52) **U.S. Cl.**

CPC ***G02B 5/0268*** (2013.01); ***G02B 5/0278*** (2013.01); ***G02B 5/045*** (2013.01); *B23B 2226/31* (2013.01); *G02B 6/0053* (2013.01); *G02B 6/0065* (2013.01); *Y10T 82/2535* (2015.01); *Y10T 428/24479* (2015.01)

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Fig. 1

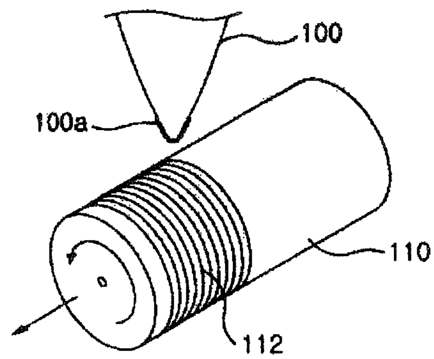
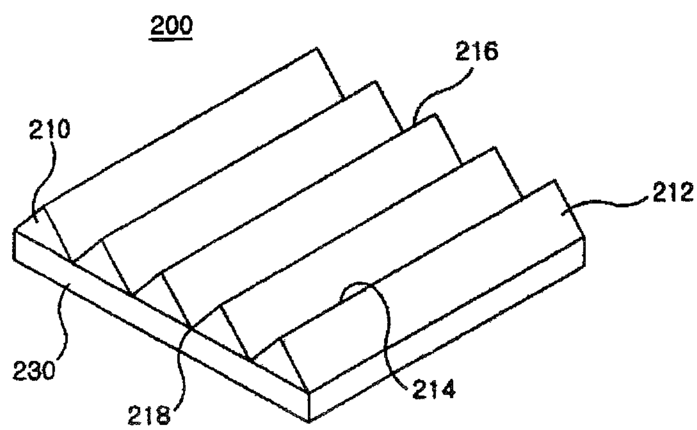


Fig. 2



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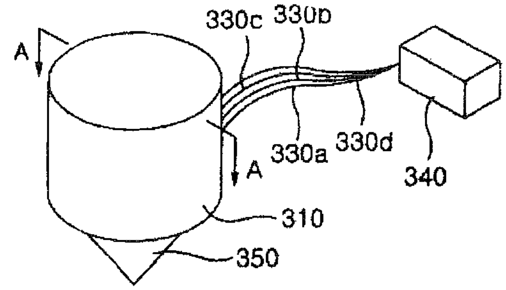


Fig. 4

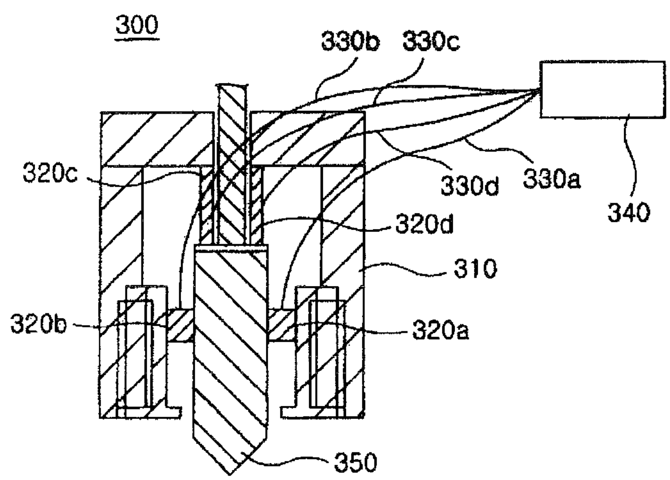


Fig. 5

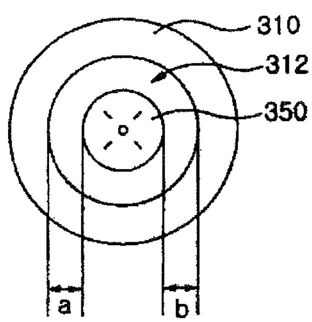


Fig. 6

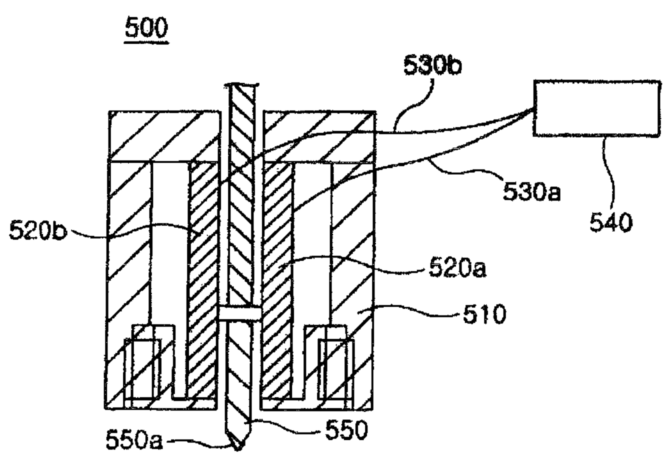


Fig. 7

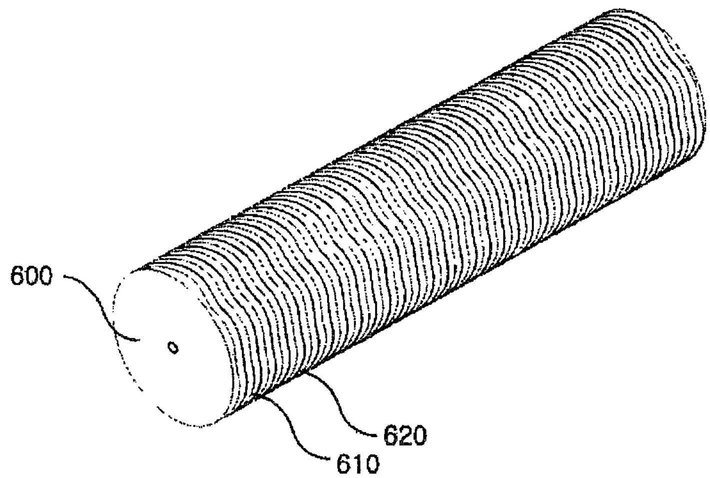


Fig. 8

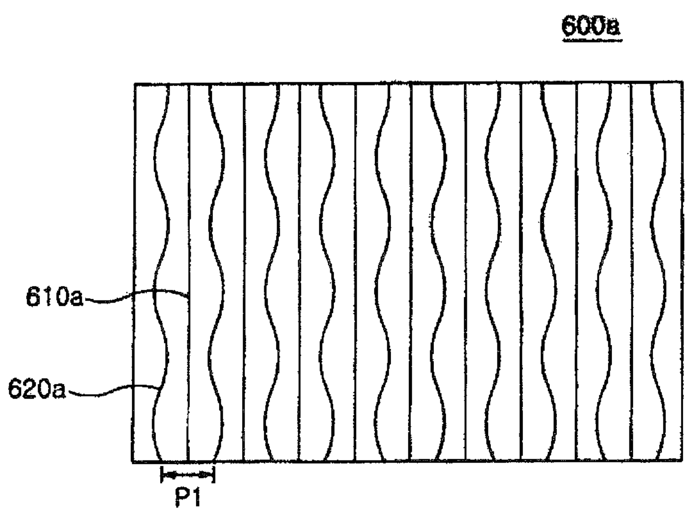


Fig. 9

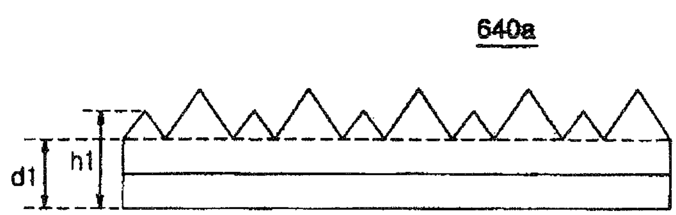


Fig. 10

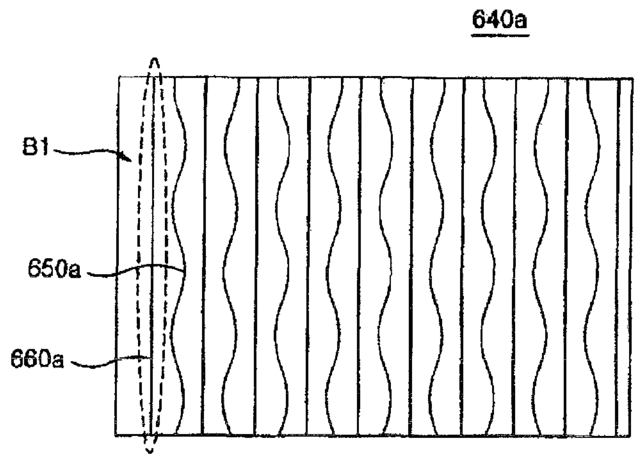
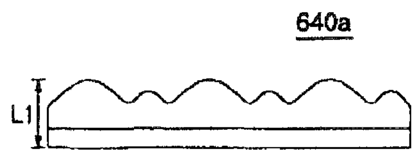


Fig. 11



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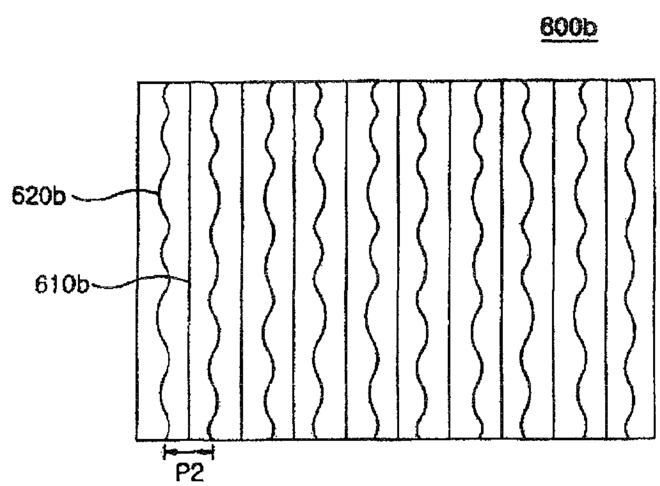

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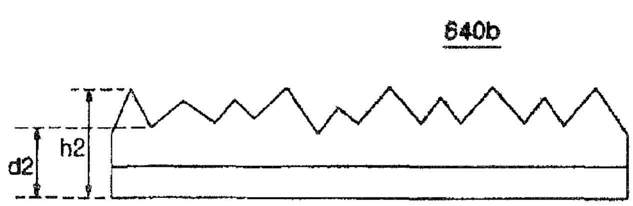

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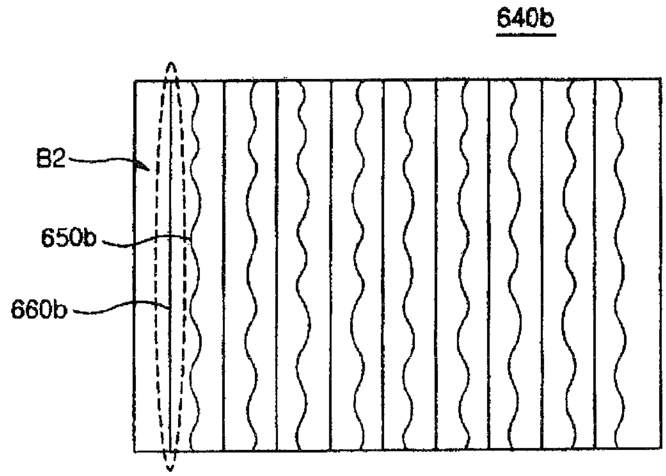


Fig. 15

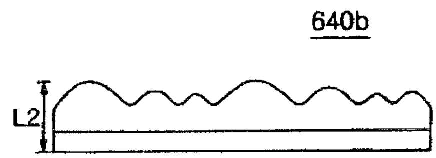


Fig. 16

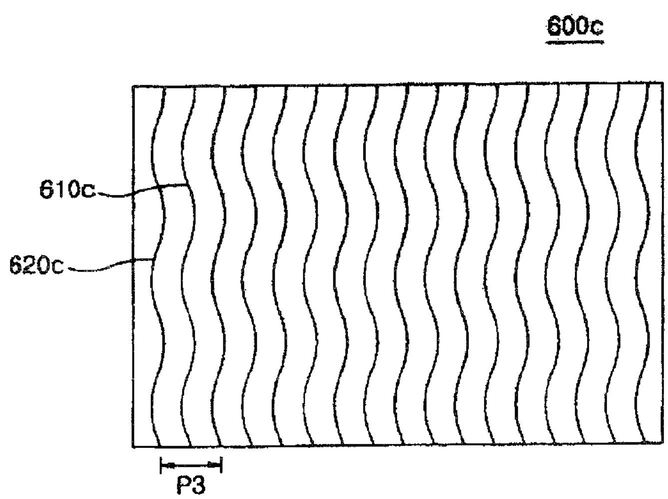
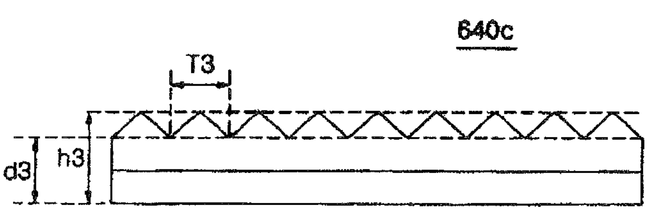


Fig. 17



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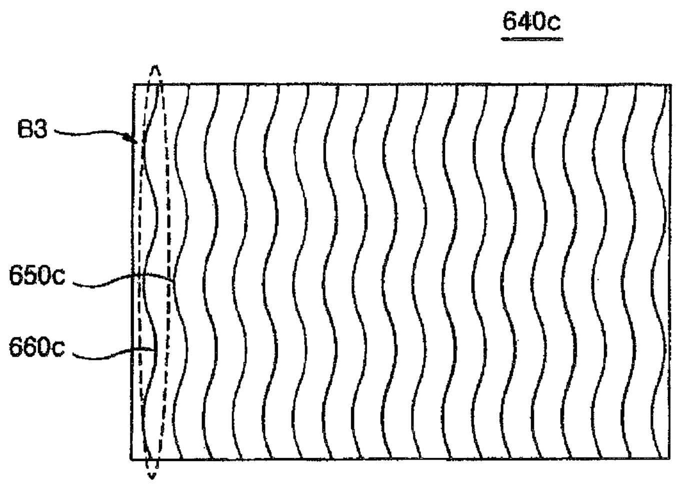


Fig. 19

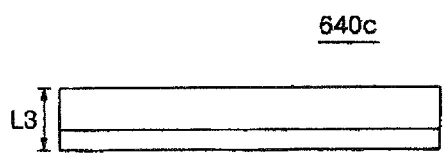


Fig. 20

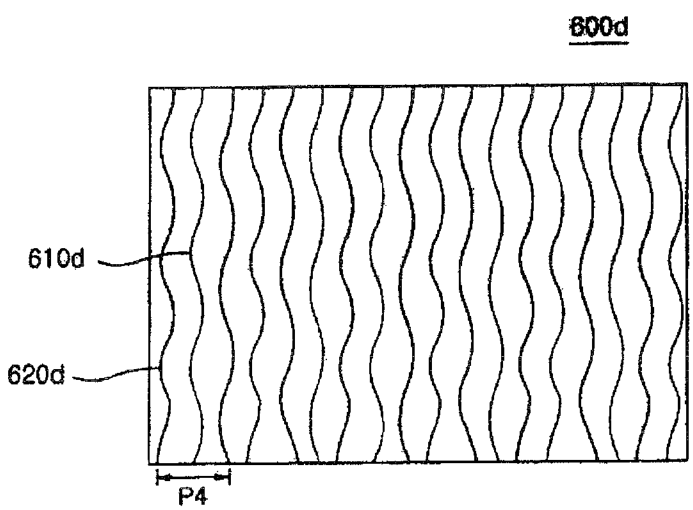


Fig. 21

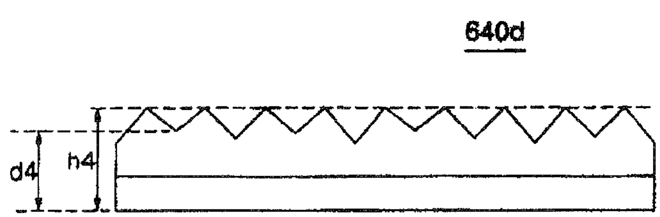
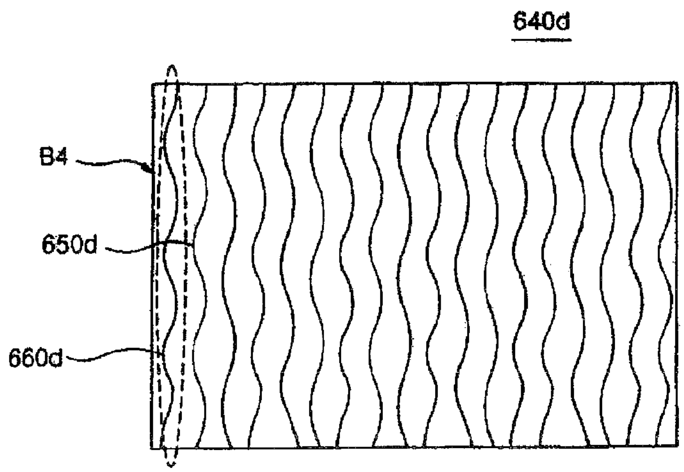


Fig. 22



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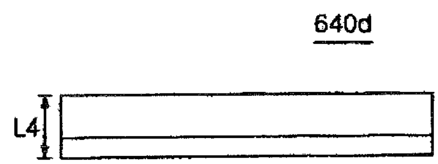


Fig. 24

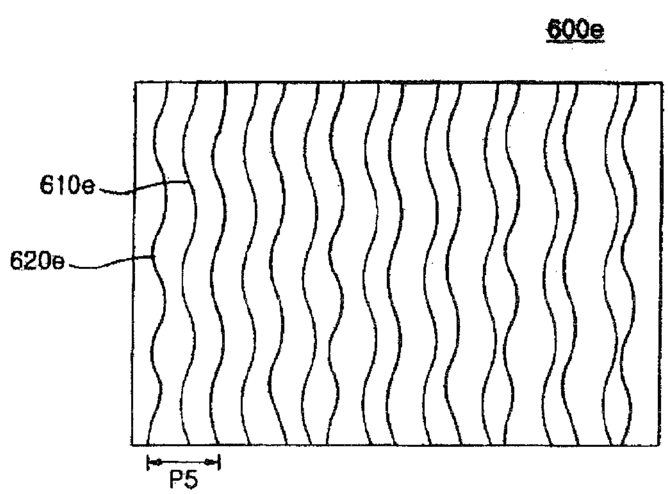
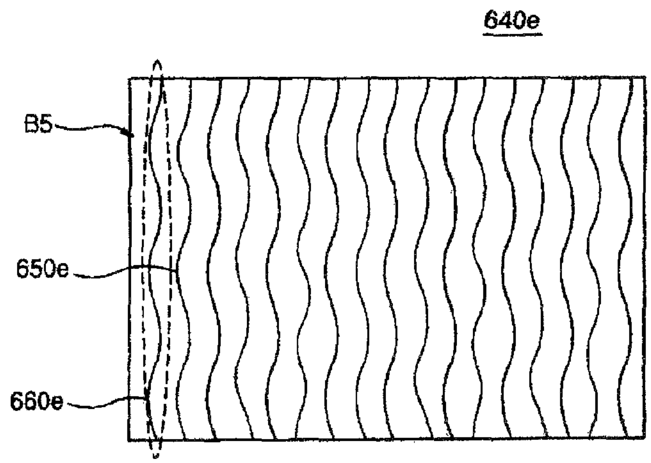


Fig. 25

Fig. 26



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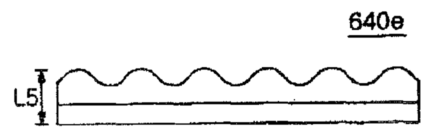


Fig. 28

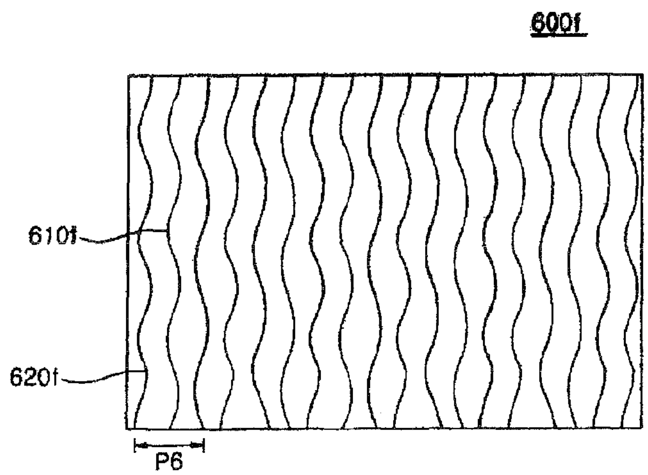


Fig. 29

Fig. 30

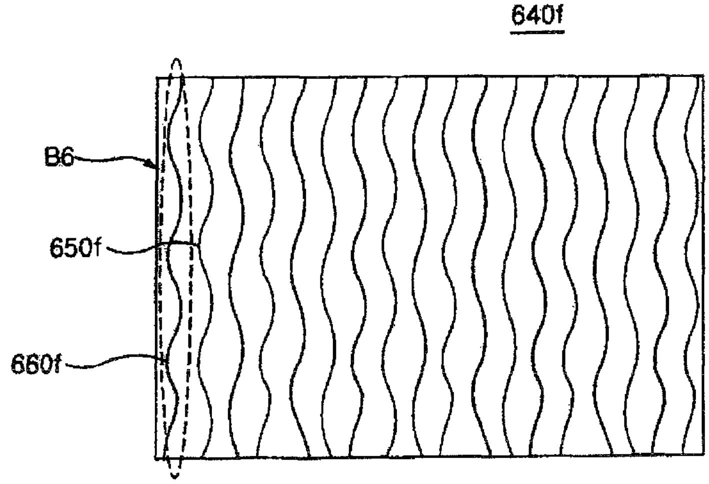


Fig. 31

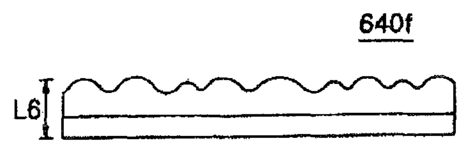
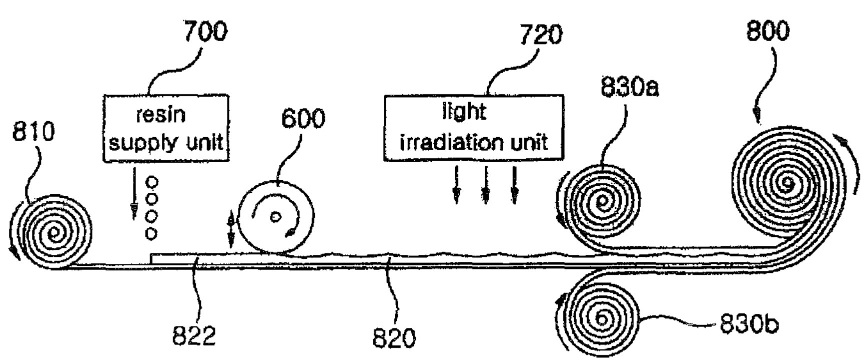


Fig. 32



MOLD, A DEVICE FOR PROCESSING THE SAME, AND A REPLICA MADE THEREFROM

CROSS-REFERENCE TO A RELATED APPLICATION

The present application claims the benefit of priority under 35 U.S.C. 119 based on the Korean patent application number 10-2006-0080071 filed on Aug. 23, 2006. This application is incorporated herein by reference in its entirety.

BACKGROUND

1. Field of the Invention

The present invention is directed to a mold. The present invention is also (Erected to a device for processing the same, and a replica made therefrom.

2. Background

Liquid crystal display known as LCD is an electronic device that changes electrical signals to visual signals by using the change of transmittance of liquid crystals according to applied voltages.

Generally, liquid crystal display comprises a liquid crystal panel displaying an image corresponding to driving signal and data signal from outside, and a backlight unit disposed at a back side of the liquid crystal panel for illuminating the panel.

The backlight unit comprises light source, reflection sheet and optical film.

The light source generates a light having a certain wavelength.

The reflection sheet reflects a light generated from the light source to proceed toward the liquid crystal panel.

The optical film comprises diffusion sheet, prism sheet and protective sheet.

The light generated from the light source passes through the diffusion sheet. Here, the diffusion sheet scatters the incident light to prevent its partial concentration and make the brightness uniform.

The brightness of the light transmitted from the diffusion sheet rapidly decreases. So, the prism sheet is used to prevent the decrease of brightness.

FIG. **1** is a view illustrating a conventional method of processing a mold.

Referring to FIG. **1**, a bite **100** to which diamond particles **100*a*** are adhered is fixed to a table and, a mold **110** is disposed under the bite **100**, and a surface of the mold **110** contacts with the bite **100**.

And, the mold **110** rotates, and moves to a left direction, and processes the bite **100**. Here, the bite **100** may move horizontally when the mold **110** rotates only.

Generally, the rotation speed and straight line movement speed of the bite **100** are constant. Therefore, the surface of the mold **110** is cut by certain amount, and a linear uniform surface **112** is obtained, as shown in FIG. **1**.

FIG. **2** is a perspective view illustrating a prism sheet manufactured by using the mold of FIG. **1**.

Referring to FIG. **2**, the prism sheet **200** comprises a prism base **230**, and an array of prisms **210** formed on the prism base **230**. The prisms **210** include side surfaces composed of a first surface **212** and a second surface **214**, and the shape of prisms **210** is approximately isoscelestriangle. Generally, the first surface **212** and the second surface **214** make a right angle, but may make other angles by selection.

A plurality of prisms **210** are disposed on the prism base **230**, and peaks **216** and grooves **218** are formed in turn. The prism sheet **200** makes a light incident from the prism base

230 refract by passing it through the prisms **210**. Accordingly, the incident light with low incident angle is focused to front side, whereby the brightness is enhanced within a valid angle of view.

However, these prisms **210** of the conventional prism sheet **200** refract the incident light toward one direction because their surfaces are flat. Therefore, the conventional prism sheet **200** has a disadvantage that it is not appropriate to refract the light in two dimensions.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects and advantages of the present invention will be better understood with regard to the following descriptions, appended claims, and accompanying drawings wherein:

FIG. **1** is a view illustrating a conventional method of processing a mold;

FIG. **2** is a perspective view illustrating a prism sheet manufactured by using the mold of FIG. **1**;

FIG. **3** is a perspective view illustrating a device for processing the mold according to one embodiment of the present invention;

FIG. **4** is a cross-sectional view illustrating the device for processing the mold in FIG. **3** taken along the line A-A;

FIG. **5** is a bottom view illustrating the device for processing the mold in FIG. **3**;

FIG. **6** is a cross-sectional view illustrating a device for processing the mold according to another embodiment of the present invention;

FIG. **7** is a perspective view illustrating the mold according to one embodiment of the present invention;

FIG. **8** is a plane view illustrating a mold according to one embodiment of the present invention;

FIG. **9** is a front view illustrating a replica manufactured by the mold in FIG. **8**;

FIG. **10** is a plane view illustrating the replica in FIG. **9**;

FIG. **11** is a side view illustrating B**1** part of FIG. **10**;

FIG. **12** is a plane view illustrating the mold according to another embodiment of the present invention;

FIG. **13** is a front view illustrating a replica manufactured by the mold in FIG. **12**;

FIG. **14** is a plane view illustrating the replica in FIG. **13**;

FIG. **15** is a side view illustrating B**2** part of FIG. **14**;

FIG. **16** is a plane view illustrating the mold according to another embodiment of the present invention;

FIG. **17** is a front view illustrating a replica manufactured by the mold in FIG. **16**;

FIG. **18** is a plane view illustrating the replica in FIG. **17**;

FIG. **19** is a side view illustrating B**3** part of FIG. **18**;

FIG. **20** is a plane view illustrating the mold according to another embodiment of the present invention;

FIG. **21** is a front view illustrating a replica manufactured by the mold in FIG. **20**;

FIG. **22** is a plane view illustrating the replica in FIG. **21**;

FIG. **23** is a side view illustrating B**4** part of FIG. **22**;

FIG. **24** is a plane view illustrating the mold according to another embodiment of the present invention;

FIG. **25** is a front view illustrating a replica manufactured by the mold in FIG. **24**;

FIG. **26** is a plane view illustrating the replica in FIG. **25**;

FIG. **27** is a side view illustrating B**5** part of FIG. **26**;

FIG. **28** is a plane view illustrating the mold according to another embodiment of the present invention;

FIG. **29** is a front view illustrating a replica manufactured by the mold in FIG. **28**;

FIG. **30** is a plane view illustrating the replica in FIG. **29**;

FIG. **31** is a side view illustrating B**6** part of FIG. **30**; and

FIG. **32** is a view illustrating a process of manufacturing the prism sheet according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

One object of the present invention is to provide a mold, a device for processing the same, and a replica made therefrom having patterns to refract a tight in two dimensions.

Another object of the present invention is to provide a mold, a device for processing the same, and a replica made therefrom whose defect is difficult to be detected visually.

Another object of the present invention is to provide a mold, a device for processing the same, and a replica made therefrom that can reduce or eliminate moiré phenomenon.

The scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

FIG. **3** is a perspective view illustrating a device for processing the mold according to one embodiment of the present invention and FIG. **4** is a cross-sectional view illustrating the device for processing the mold in FIG. **3** taken along the line A-A.

Referring to FIGS. **3** and **4**, the processing device **300** of the present invention comprises housing **310**, at least one piezoelectric element **320***a*, **320***b*, **320***c*, and **320***d*, signal generator **340**, and cutting unit **350**.

The housing **310** accommodates the cutting unit **350**, and has an aperture **312** through which a portion of the cutting unit **350** protrudes. The shape of the housing **310** shown in FIGS. **3** and **4** may be changed to one which can fix to a processing table (not shown).

At least one piezoelectric element **320***a*, **320***b*, **320***c*, and **320***d* is disposed between the cutting unit **350** and the housing **310**.

When a voltage is applied to the piezoelectric element **320***a*, **320***b*, **320***c*, and **320***d*, a mechanical displacement occurs to the piezoelectric element. On the contrary, when a stress or vibration is applied to the piezoelectric element **320***a*, **320***b*, **320***c*, and **320***d*, an electrical signal is generated therefrom.

According to one embodiment of the present invention, the piezoelectric element **320***a* and **320***b* disposed in a side wall of the housing **310** produces a mechanical displacement horizontally when the electrical signal is applied thereto.

Also, the piezoelectric element **320***c* and **320***d* disposed in an upper wall of the housing **310** produces a mechanical displacement vertically when the electrical signal is applied thereto. Here, the mechanical displacement in the vertical direction may be in the range of about 1 μm to 4 μm. Therefore, the cutting unit **350** of the processing device **300** of the present invention may have certain displacement vertically and horizontally, and a random displacement may occur by combination of mechanical displacement of each piezoelectric element **320***a*, **320***b*, **320***c*, and **320***d*.

The processing device **300** shown in FIG. **4** have four piezoelectric elements **320***a*, **320***b*, **320***c*, and **320***d* in the housing **310**, but is not kited to such constitution. For example, one piezoelectric element may be disposed in the housing **310**, and more piezoelectric elements may be disposed to control the displacement of the cutting unit **350** more precisely.

The piezoelectric element **320***a*, **320***b*, **320***c* and **320***d* includes at least one selected from the group consisting of rochelle salts, barium titanate and PZT.

According to one embodiment of the present invention, the piezoelectric elements **320***a*, **320***b*, **320***c* and **320***d* each have different piezo-electric modulus. Accordingly, the mechanical displacement of each piezoelectric element **320***a*, **320***b*, **320***c*, and **320***d* may be different even though same electrical signal is applied to each piezoelectric element **320***a*, **320***b*, **320***c*, and **320***d*.

The signal generator **340** applies an electrical signal to the piezoelectric elements **320***a*, **320***b*, **320***c* and **320***d*, and induces the piezoelectric elements **320***a*, **320***b*, **320***c* and **320***d* to produce a mechanical displacement.

Connection lines **530***a* and **530***b* are intermediate lines which transfer the electrical signal generated from the signal generator **540** to the piezoelectric elements **520***a* and **520***b*.

The signal generator **340** may be a DC voltage generator, a variable AC voltage generator, or a function generator.

In case a voltage generated from the signal generator **340** is applied to the piezo-electric elements **320***a*, **320***b*, **320***c* and **320***d*, the piezoelectric elements **320***a*, **320***b*, **320***c* and **320***d* produce mechanical displacement corresponding to the voltage variable.

The cutting unit **350** carves a surface of the mold **600**. The cutting unit **350** includes at least one material selected from the group consisting of carbon steel, high speed steel, hard metal and ceramics.

The cutting unit **350** is connected to the piezoelectric elements **320***a*, **320***b*, **320***c* and **320***d*, and so causes a displacement corresponding to a mechanical displacement of the piezoelectric element **320***a*, **320***b*, **320***c* and **320***d*.

FIG. **5** is a bottom view illustrating a device for processing the mold in FIG. **3**.

Referring to FIG. **5**, the cutting unit **350** is spaced apart from the aperture of the housing **310** by a distance (a+b). Therefore, the cutting unit **350** accommodated in the hosing **310** may produce a displacement within the predetermined distance (a+b).

Accordingly, even though the piezoelectric elements **320***a*, **320***b*, **320***c* and **320***d* produce excessive displacement by malfunction of the signal generator **340**, the cutting unit **350** produces a displacement within a predetermined distance.

According to one embodiment of the present invention, the distance (a+b) is in the range of about 1 μm to 4 μm.

FIG. **6** is a cross-sectional view illustrating a device for processing the mold according to another embodiment of the present invention.

Referring to FIG. **6**, two piezoelectric elements **520***a* and **520***b* are disposed between the cutting unit **550** and the housing **510**.

According to one embodiment of the present invention, the piezoelectric elements **520***a* and **520***b* each have different piezo-electric modulus. Accordingly, the cutting unit **550** may produce a horizontal displacement as well as a vertical displacement.

For example, in case the vertical displacement of one piezoelectric element **520***a* is larger than that of other piezoelectric element **520***b* when same electrical signal is applied to the piezoelectric elements **520***a* and **520***b*, the cutting unit **550** produces a horizontal displacement as well as a vertical displacement.

In FIG. **6**, diamond particles **550***a* may be adhered onto a portion of the cutting unit **550**, contacting with the surface of the mold 600, whereby the cutting unit 550 may have enhanced durability and hardness.

FIG. 7 is a perspective view illustrating the mold according to one embodiment of the present invention.

Referring to FIG. 7, the mold 600 of the present invention is processed by the processing device 300 and 500 as shown in FIGS. 4 and 6. And, the mold 600 comprises a plurality of linear peaks 620 and grooves 610 that are formed on a surface of the mold 600. Here, both or one of the peaks 620 and grooves 610 have random or periodic meandering-shape.

The depth of the peak 620 and the height of the groove 610 are determined by operation of the cutting unit 350 and 550, and so may change randomly or periodically, or may be constant.

FIG. 8 is a plane view illustrating the mold according to one embodiment of the present invention.

In case the processing device 300 and 500 vibrates periodically in the vertical direction, the mold 600*a* as shown in FIG. 8 is formed.

The processing device 300 and 500 does not produce a horizontal displacement, and so the groove 610*a* of the mold 600*a* is formed according to the straight direction. However, the depth of the groove 610*a* is changed.

The peaks 620*a* are formed symmetrically to the axis of groove 610*a*, and the distance P1 between peaks 620*a* changes periodically.

FIG. 9 is a front view illustrating a replica manufactured by the mold in FIG. 8.

FIG. 10 is a plane view illustrating the replica in FIG. 9; and FIG. 11 is a side view illustrating B1 part of FIG. 10.

Referring to FIGS. 9 to 11, a plurality of linear crests 660*a* and valleys 650*a* are formed on a surface of the replica 640*a*.

The crests 660*a* of the replica 640*a* correspond to the grooves 610*a* of the mold 600*a*, and the valleys 650*a* of the replica 640*a* correspond to the peaks 620*a* of the mold 600*a*.

The groove 610*a* of the mold 600*a* as shown in FIG. 8 is formed in the straight direction, and so the crest 660*a* of the replica 640*a* is also formed in the straight direction. And, the peaks 620*a* of the mold 600*a* are formed symmetrically to the axis of groove 610*a*, and so the valleys 650*a* of the replica 640*a* are also formed symmetrically to the axis of crest 660*a*.

In each line of prisms, the height (h1) of the replica 640*a* from bottom to crest 660*a* changes periodically, and the distance (d1) of the replica 640*a* from bottom to valleys 650*a* is constant.

Referring to FIG. 11, observing the crest 660*a* formed on one line of the replica 640*a* from the side, the height (L1) of the crest 660*a* changes periodically.

FIG. 12 is a plane view illustrating the mold according to another embodiment of the present invention.

In case the processing device 300 and 500 vibrates randomly in the vertical direction, the mold 600*b* as shown in FIG. 12 is formed.

The processing device 300 and 500 does not produce a horizontal displacement, and so the groove 610*b* of the mold 600*b* is formed to the straight direction. However, the depth of the groove 610*b* changes randomly according to the vertical vibration of the processing device 300 and 500.

The height of the peak 620*b* changes randomly, and the distance (P2) between peaks 620*b* changes randomly.

FIG. 13 is a front view illustrating a replica manufactured by the mold in FIG. 12.

FIG. 14 is a plane view illustrating the replica in FIG. 13; and FIG. 15 is a side view illustrating B2 part of FIG. 14.

Referring to FIGS. 13 to 15, a plurality of linear crests 660*b* and valleys 650*b* are formed on a surface of the replica 640*b*.

The crests 660*b* of the replica 640*b* correspond to the grooves 610*b* of the mold 600*b*, and the valleys 650*b* of the replica 640*b* correspond to the peaks 620*b* of the mold 600*b*.

The groove 610*b* of the mold 600*b* as shown in FIG. 12 is formed in the straight direction, and so the crest 660*b* of the replica 640*b* is also formed in the straight direction. Also, the peaks 620*b* of the mold 600*b* have random meandering-shape, and so the valleys 650*b* of the replica 640*b* also have random meandering-shape.

In each line of prisms, the height (h2) of the replica 640*b* from bottom to crest 660*b* changes randomly, and the distance (d2) of the replica 640*b* from bottom to valleys 650*b* changes randomly.

Referring to FIG. 15, observing the crest 660*b* in one line of replica 640*b* from the side, the height (L2) of the crest 660*b* changes randomly.

FIG. 16 is a plane view illustrating the mold according to another embodiment of the present invention.

In case the processing device 300 and 500 vibrates periodically in the horizontal direction, the mold 600*c* as shown in FIG. 16 is formed.

The grooves 610*c* and peaks 620*c* of the mold 600*c* have periodic meandering-shape.

The processing device 300 and 500 does not produce a vertical displacement, and so the depth of grooves 610*c* and the height of peaks 620*c* are constant, and the distance (P3) between peaks 620*c* is constant.

FIG. 17 is a front view illustrating a replica manufactured by the mold in FIG. 16.

FIG. 18 is a plane view illustrating the replica in FIG. 17; and FIG. 19 is a side view illustrating B3 part of FIG. 18.

Referring to FIGS. 17 to 19, a plurality of linear crests 660*c* and valleys 650*c* are formed on a surface of the replica 640*c*.

The crests 660*c* of the replica 640*c* correspond to the grooves 610*c* of the mold 600*c*, and the valleys 650*c* of the replica 640*c* correspond to the peaks 620*c* of the mold 600*c*.

The grooves 610*c* and peaks 620*c* of the mold 600*c* have periodic meandering-shape as shown in FIG. 16, and so the crests 660*c* and valleys 650*c* of the replica 640*c* also have periodic meandering-shape.

In each line of prisms, the height (h3) of replica 640*c* from bottom to crest 660*c* is constant, and the distance (d3) of the replica 640*c* from bottom to valleys 650*c* is constant.

Also, the distance (P3) between peaks 620*c* of the mold 600*c* shown in FIG. 16 is constant, and so the distance (T3) between valleys 650*c* of the replica 640*c* is constant.

Referring to FIG. 19, observing the crest 660*c* in one line of replica 640*c* from the side, the height (L3) of the crest 660*c* is constant.

FIG. 20 is a plane view illustrating the mold according to another embodiment of the present invention.

In case the processing device 300 and 500 vibrates randomly in the horizontal direction, the mold 600*d* as shown in FIG. 20 is formed.

The grooves 610*d* and peaks 620*d* of the mold 600*d* have random meandering-shape.

The processing device 300 and 500 does not produce a vertical displacement, and so the depth of grooves 620*d* is constant. However, the height of peaks 620*d* changes randomly. And, the distance (P4) between peaks 620*d* changes randomly.

FIG. 21 is a front view illustrating a replica manufactured by the mold in FIG. 20.

FIG. 22 is a plane view illustrating the replica in FIG. 21; and FIG. 23 is a side view illustrating B4 part of FIG. 22.

Referring to FIGS. 21 to 23, a plurality of linear crests 660*d* and valleys 650*d* are formed on a surface of the replica 640*d*.

The crests **660***d* of the replica **640***d* correspond to the grooves **610***d* of the mold **600***d*, and the valleys **650***d* of the replica **640***d* correspond to the peaks **620***d* of the mold **600***d*.

The grooves **610***d* and peaks **620***d* of the mold **600***d* have random meandering-shape as shown in FIG. **20**, and so the crests **660***d* and valleys **650***d* of the replica **640***d* also have random meandering-shape.

In each line of prisms, the height (h**4**) of the replica **640***d* from bottom to crest **660***d* is constant, and the distance (d**4**) of the replica **640***d* from bottom to valleys **650***d* changes randomly.

Referring to FIG. **23**, observing the crest **660***d* in one line of replica **640***d* from the side, the height (L**4**) of the crest **660***d* is constant.

FIG. **24** is a plane view illustrating the mold according to another embodiment of the present invention.

In case the processing device **300** and **500***d* vibrates periodically in the horizontal and vertical directions, the mold **600***e* as shown in FIG. **24** is formed.

The grooves **610***e* of the mold **600***e* have periodic meandering-shape, and the depth of groove **610***e* changes periodically.

The peaks **620***e* of the mold **600***e* have random meandering-shape, and the height of peak **620***e* changes randomly. Also, the distance (P**5**) between peaks **620***e* changes randomly.

FIG. **25** is a front view illustrating a replica manufactured by the mold in FIG. **24**.

FIG. **26** is a plane view illustrating the replica in FIG. **25**; and FIG. **27** is a side view illustrating B**5** part of FIG. **26**.

Referring to FIGS. **25** to **27**, a plurality of linear crests **660***e* and valleys **650***e* are formed on a surface of the replica **640***e*.

The crests **660***e* of the replica **640***e* correspond to the grooves **610***e* of the mold **600***e*, and the valleys **650***e* of the replica **640***e* correspond to the peaks **620***e* of the mold **600***e*.

The grooves **610***e* of the mold **600***e* have periodic meandering-shape as shown in FIG. **24**, and so the crests **660***e* of the replica **640***e* have periodic meandering-shape. And, the peaks **620***e* of the mold **600***e* have random meandering-shape, and so the valleys **650***e* of the replica **640***e* also have periodic meandering-shape.

In each line of prisms, the height (h**5**) of the replica **640***e* from bottom to crest **660***e* changes randomly, and also the distance (d**5**) of the replica **640***e* from bottom to valleys **650***e* changes randomly.

Referring to FIG. **27**, observing the crest **660***e* in one line of replica **640***e* from the side, the height (L**5**) of the crest **660***e* changes periodically.

FIG. **28** is a plane view illustrating the mold according to another embodiment of the present invention.

In case the processing device **300** and **500** vibrates randomly in the horizontal and vertical directions, the mold **600***f* as shown in FIG. **28** is formed.

The grooves **610***f* and peaks **620***f* of the mold **600***f* have periodic meandering-shape, and the height of peak **620***f* and the depth of grooves **610***f* changes randomly. Accordingly, the distance (P**6**) between peaks **620***f* changes randomly.

FIG. **29** is a front view illustrating a replica manufactured by the mold in FIG. **28**.

FIG. **30** is a plane view illustrating the replica in FIG. **29**; and FIG. **31** is a side view illustrating B**6** part of FIG. **30**.

Referring to FIGS. **29** to **31**, a plurality of linear crests **660***f* and valleys **650***f* are formed on a surface of the replica **640***f*.

The crests **660***f* of the replica **640***f* correspond to the grooves **610***f* of the mold **600***f*, and the valleys **650***f* of the replica **640***f* correspond to the peaks **620***f* of the mold **600***f*.

The grooves **610***f* and peaks **620***f* of the mold **600***f* have random meandering-shape as shown in FIG. **28**, and so the crests **660***f* and valleys **650***f* of the replica **640***f* have random meandering-shape.

In each line of prisms, the height (h**6**) of the replica **640***f* from bottom to crest **660***f* changes randomly, and also the distance (d**6**) of the replica **640***f* from bottom to valleys **650***f* changes randomly.

Referring to FIG. **31**, observing the crest **660***f* in one line of replica **640***f* from the side, the height (L**6**) of the crest **660***f* changes randomly.

FIG. **32** is a view illustrating a process of manufacturing the prism sheet according to one embodiment of the present invention.

Referring to FIG. **32**, a device for manufacturing the prism sheet comprises a resin supply unit **700**, a mold **600**, and a light irradiation unit **720**.

First, as shown in FIG. **32**, a base film **810** is supplied successively to the manufacturing device.

The base film **810** is an optical film, and preferably is a thermoplastic polymer film which is transparent and flexible, and has superior processability.

When the base film **810** is supplied to the manufacturing device, the resin supply unit **700** applies a light curative resin **822** onto the base film **810** with a prescribed thickness.

When the resin supply unit **700** applies a certain amount of light curative resin **822** to the base film **810**, it is controlled that the light curative resin **822** is applied onto the surface of the base film **810** in a certain thickness.

Then, the base film **810** to which the light curative resin **822** is applied moves to the mold **600**.

Then, the mold **600** rotates in a certain direction, and processes the light curative resin **822** applied onto the base film **810**. In case the base film **810** to which the light curative resin **822** is applied passes through the mold **600**, a pattern corresponding to the pattern of the mold **600** is formed on the surface of the light curative resin **822**, and the pattern forms a plurality of prisms **820**.

Subsequently, the light curative resin **822** with the pattern of prisms **820** is moved to the light irradiation unit **720**.

The light irradiation unit **720** irradiates a light to the light curative resin **822** for a prescribed time. Here, the light, for example UV, may be irradiated onto the light curative resin **822** to cure the prisms **820**.

Then, protective films **830***a* and **830***b* cover the prism sheet **800** comprising the base film **810** and the prisms **820** above and below the surface of the prism sheet **800**, which is then coiled into a roll.

The height of crests of the prism sheet **800** manufactured by the above process changes randomly. Thus, a defect from physical contractions between the prism sheet **800** and other optical films is difficult to be detected visually.

The prism sheet manufactured by the mold of the present invention has random pattern, and so it may reduce or eliminate moiré phenomenon which is occurred by repetition of constant pattern.

FIG. **32** explains the prism sheet as the replica, but the present invention is not limited to the embodiment, and any replica manufactured by the mold of the present invention may be covered by the present invention.

Any reference in this specification to “one embodiment,” “an embodiment,” “example embodiment,” etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

The invention claimed is:

1. A device for processing a mold, comprising:

a cutter configured to contact a surface of the mold and carve a plurality of peaks and grooves on the surface of the mold, the cutter being made from at least one of carbon steel, high speed steel, hard metal, or ceramics, the cutter having diamond particles that are adhered to a portion contacting the surface of the mold;

a housing configured to have an area that accommodates the cutter and an aperture through which a portion of the cutter protrudes, wherein the cutter is spaced apart from the aperture by a predetermined distance;

at least two piezoelectric elements configured to apply a mechanical variation to the cutter, the piezoelectric elements each having a different piezo-electric modulus and each being made from at least one of rochelle salts, barium titanate, or PZT, the at least two piezoelectric elements comprising a first piezoelectric element and a second piezoelectric element; and

a signal generator configured to apply an electrical signal to induce a vertical displacement of the piezoelectric elements wherein the first piezoelectric element and the second piezoelectric element produce different vertical displacements even though the electrical signal transmitted to the first and second piezoelectric elements is identical,

wherein the cutter produces a horizontal displacement along with a vertical displacement produced by the different vertical displacements of the first and second piezoelectric elements,

wherein the peaks and grooves carved by the cutter have a randomly varying shape.

2. The device of claim **1**, wherein the distance is in the range of 1 μm to 4 μm.

3. The device of claim **1**, wherein the mechanical variation is in an up and down direction, a right and left direction, or an up and down/right and left direction.

4. The device of claim **1**, wherein the signal generator applies the same signal to each piezoelectric element.

5. The device of claim **1**, wherein the at least two piezoelectric elements comprise exactly two piezoelectric elements positioned to displace the cutter both in a horizontal and a vertical direction simultaneously.

6. The device of claim **1**, wherein the piezoelectric elements combine to produce a random horizontal and a random vertical displacement to the cutter.

7. The device of claim **6**, wherein the at least two piezoelectric elements comprise exactly two piezoelectric elements positioned to combine to produce a random horizontal and a random vertical displacement to the cutter simultaneously.

8. The device of claim **1**, wherein the signal generator applies the same signal to each piezoelectric element and wherein the piezoelectric elements combine to produce a random horizontal and a random vertical displacement to the cutter simultaneously.

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